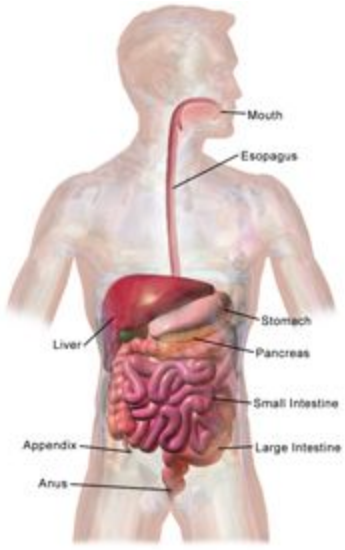
Human Digestive System

Human Digestive system includes Gastrointestinal Tract and other accessory parts like the liver, intestines, glands, mouth, stomach, gallbladder. There are 6 main functions of the Human Digestive System Process: Ingestion, Motility, Secretion, Digestion, Absorption, Excretion. The food that you eat gives you not only the required energy and nutrients to the body but also is used for cell growth and repair.

Human Digestive System



Digestive System

(Source: Wikipedia)

In Human digestive system, there are many parts that work together. The food that you eat has biomacromolecules, which are nothing but the carbohydrates (such as sugars), proteins, lipids (such as fats), and nucleic acids. These have to be converted to their simpler forms so that your body can absorb it. These biomacromolecules are the building blocks that you require to maintain your body, which is also made of these large biological molecules, along with water!

This process of converting complex food substances (molecules) into simpler forms to facilitate absorption is called Digestion. In humans, this system consists of many parts and organs, including the alimentary canal, digestive glands, and a few accessory organs such as the teeth, salivary glands, tongue, pancreas, liver, gallbladder etc.

Nevertheless, the starting point where digestion actually starts in the mouth! From the mouth, it passes through the alimentary canal, which is also called the gastrointestinal tract. This tract consists of the pharynx, esophagus, stomach, small intestine, large intestine, and anus. The mouth can be considered as the anterior opening of the alimentary canal, while the anus is the posterior opening.

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Digestive System Process:

From the Mouth to the Large Intestine and Anus. The Human digestive system process can be divided into stages, namely:

- Ingestion
- Motility
- Secretion
- Digestion
- Absorption
- Excretion

The whole process starts in the oral cavity, where the saliva from the salivary glands mixes with the food and starts to begin the breakdown of food. From the mouth, the food passes to the hollow tube-like organ the esophagus. From the esophagus, food then travels to the stomach,

where it breaks down further with the help of the acids and powerful enzymes secreted by the stomach.

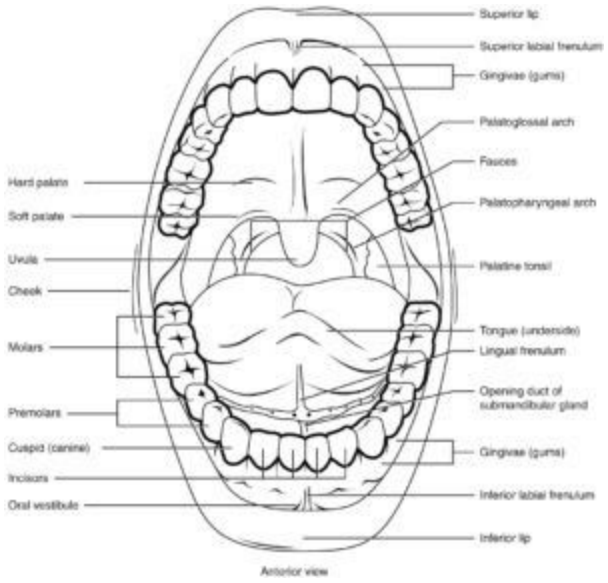
This semi-digested food then travels down to the small intestine, where secretions from the liver, gallbladder, and pancreas further act on the food particles. The small intestine is divided into three parts called the duodenum, jejunum, and ileum. Most of the digestion takes place here in the small intestine, where absorption also occurs. Once most of the absorption of water and digested nutrients is completed in the small intestine, the remaining waste products move to the large intestine. The large intestine divides into appendix, caecum, colon, and rectum. The faecal matter from the large intestine comes out through the anus.

Digestive System Parts:

Mouth

The anterior opening of the alimentary canal is the mouth. It leads to a buccal cavity or oral cavity, where teeth, tongue and salivary glands are present. Here, ingestion, mastication, and swallowing of food occur. In humans, there are a total of 32 permanent teeth. There are

four different types of teeth, namely, incisors, canines, premolars, and molars. These help in the chewing of food.



(Source: Wikipedia)

Salivary Glands

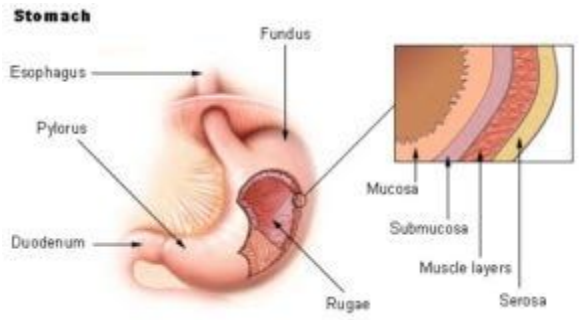
They are exocrine glands that produce saliva in the oral cavity. They secrete an enzyme called amylase, which helps in the breakdown of starch into maltose. There are three types of salivary glands, namely:

- Parotid gland
- Submandibular gland

- Sublingual gland

Stomach

The esophagus leads to a sac-like organ called the stomach. It is a muscular, hollow organ, having a capacity of 1 litre. The stomach holds food and also is a mixer and grinder. It secretes strong acids and powerful enzymes that help in the process of breaking down of food. Food is generally in a liquid or pastes consistency when it leaves the stomach.



(Source: Wikipedia)

Small Intestine

The small intestine is a long tube, which loosely coils in the abdomen area. Here, enzymes from the pancreas and liver further break down the food. Three segments make up the small intestines, which are the

duodenum, jejunum, and ileum. The contractions of the small intestine help in the movement of food, along with its breakdown, after mixing with the digestive secretions. The jejunum and ileum areas of the small intestine are responsible for the absorption of food into the blood, though their villi.

Pancreas, Liver and Gall Bladder

These organs also play a significant role in the human digestive system. The pancreas secretes enzymes which help in the breakdown protein, fat, and carbohydrate. The liver secretes bile and cleanses and purifies the blood coming from the small intestine. The gallbladder stores the bile that the liver produces. It releases bile into the small intestine to aid in the digestion process.

Large Intestine

The large intestine is a long muscular tube that has different parts, which are caecum, colon, and rectum. The waste that is left over after digestion of food, reaches the rectum through the peristaltic movements of the colon.

Digestive System Controls

Hormones and nerves control the human digestive system. The walls of the alimentary canal have many sensors which regulate the digestive functions. Even hormones are involved in the digestion process. The main digestive hormone, gastrin is secreted in response to the presence of food. Gastrin again stimulates the gastric acid secretion. All these regulate the digestion process.

Solved Questions For You

Q: What is digestion?

Ans. Digestion is the process of converting complex food substances (molecules) into simpler forms to facilitate absorption.

Q: What are the various organs and parts associated with the Human Digestive System?

Ans. The Digestive System in humans starts with the mouth or oral cavity, leading to the alimentary canal. The alimentary canal consists of the following – pharynx, esophagus, stomach, small intestine, large intestine, and anus. The small intestine divides into three parts namely, the duodenum, jejunum, and ileum, while the large intestine divides into an appendix, caecum, colon, and rectum. The liver, gallbladder,

pancreas, teeth, salivary glands, tongue, etc. also have a role to play in the digestive system.

Process of Digestion

We all associate the process of digestion with the stomach, right? But what if I told you, the digestive process starts from the mouth itself. There are various other organs involved in the digestion process occurring in the human body. Let us educate ourselves about this process.

Digestion Process

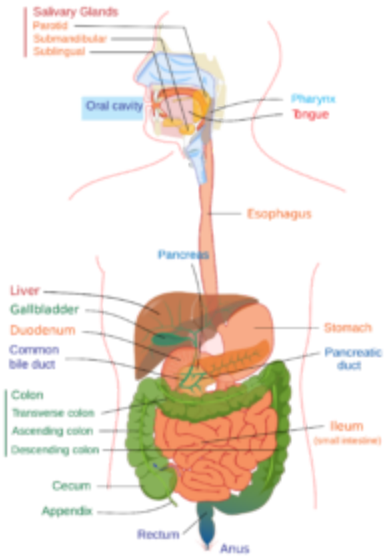
The digestion process is a series of reactions of food with the digestive hormones and juices. This starts right from the oral cavity.

Why is digestion important?

It is an important process that breaks down the proteins, fats, carbohydrates, vitamins, minerals into simpler forms so that it can be absorbed easily into the body cells. During this process, proteins are

converted into amino acids, carbohydrates are converted into simple sugars and fats are broken down into fatty acids and glycerol.

Many digestive enzymes and hormones act on food, at various stages during the process of digestion. The whole process occurs in a sequential manner.



(Source: Wikimedia)

The following table shows the digestive process in a simple format.

Organ	Movement	Digestive juices/enzymes added	Food that is broken down
Mouth	Chewing	Saliva	Starch(Carbohydrate)
Oesophagus	Peristalsis	—	—
Stomach	Churning	Stomach acid and Digestive Enzymes	Proteins
Small Intestine	Peristalsis	Digestive Juices	Carbohydrates, proteins, starch
Pancreas	—	Pancreatic juice	Carbohydrates, Fats, proteins
Liver	—	Bile	Fats

Large Intestine	Peristalsis	—	Bacteria act on the remaining food particles.

Mechanism of Digestion

The digestion process can be divided into different stages, such as digestion in the:

- Oral cavity
- Stomach
- Small intestine
- Large intestine

Digestion includes a complex combination of mechanical and chemical processes. Some of the activities in the process include ingestion and propulsion of food, mechanical or physical digestion, chemical digestion, absorption, and defecation.

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- Digestive System
- Absorption and Assimilation

- Disorders of Digestive System

Digestion in the Oral Cavity

When food is taken in through the mouth, chewing and mixing of the food occurs. There is also a chemical breakdown of carbohydrates, due to the action of saliva from the salivary glands. 30% of the starch is hydrolyzed by the action of amylase, which is a salivary enzyme. The other enzyme, lysozyme is an antibacterial agent that prevents infections.

Starch + Salivary amylase → Maltose

Mastication of food and swallowing of food are the important activities that take place here in the oral cavity. Food is broken down into smaller particles by the chewing action of teeth. As saliva is added, it mixes with the food particles, slowly moistening and lubricating the food. This small ball is called a bolus, which is then swallowed. The pharynx helps in the movement of the bolus into the oesophagus, from where it moves to the stomach through the peristaltic movements of the oesophagus.

Learn more about the Human Digestive System here in detail.

Digestion in the Stomach

When food reaches the stomach, it stays for approximately 4 to 5 hours. There are various gastric glands in the mucosa lining of the stomach. The mucus neck cells secrete mucus. The Peptic Cells secrete the proenzyme pepsinogen. The Parietal or Oxyntic Cells secrete HCl (Hydrochloric acid) and intrinsic factor that is essential for vitamin B12 absorption.

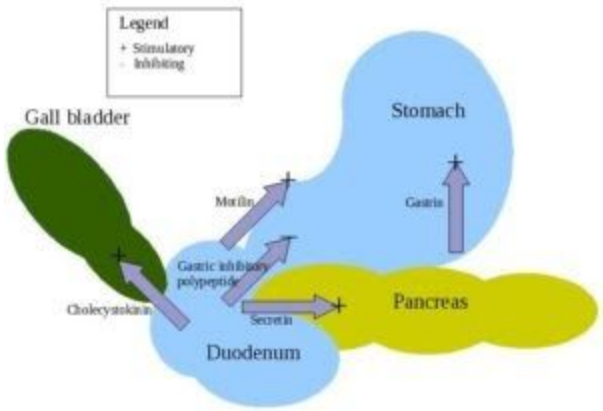
Food in the stomach gets mixed thoroughly with the gastric juices through the churning movements of the stomach muscle. This mass of food that is semi-digested, acidic and pulpy is called the chyme. It is mostly the proteins that get digested in the stomach. The mucus and the bicarbonates of the gastric juice help in protecting the mucosal epithelium from the highly acidic HCl. Mucus also helps in lubricating the food.

The different chemical reactions that take place in the stomach are summarised as follows.

- *Gastric juices and enzymes:*

- HCl provides the acidic pH.
- Pepsinogen(proenzyme) is converted into Pepsin by HCl
- Pepsin, in turn, converts protein into peptones & proteoses.
- Prorenin (proenzyme) is converted into Renin by HCl.
- Casein (milk protein) is converted into peptides by Renin.

After the action of the gastric juices and enzymes, food then enters the small intestine.



(Source: Wikipedia)

Digestion in the Small Intestine

In the small intestine, further digestion takes place. Due to the various movements of this organ, the chyme is further mixed and churned. There are many enzymes that are secreted into the small intestine from organs such as pancreas, liver; apart from the intestinal juices. All these react with the food particles and digest them into smaller particles that can be absorbed into the bloodstream.

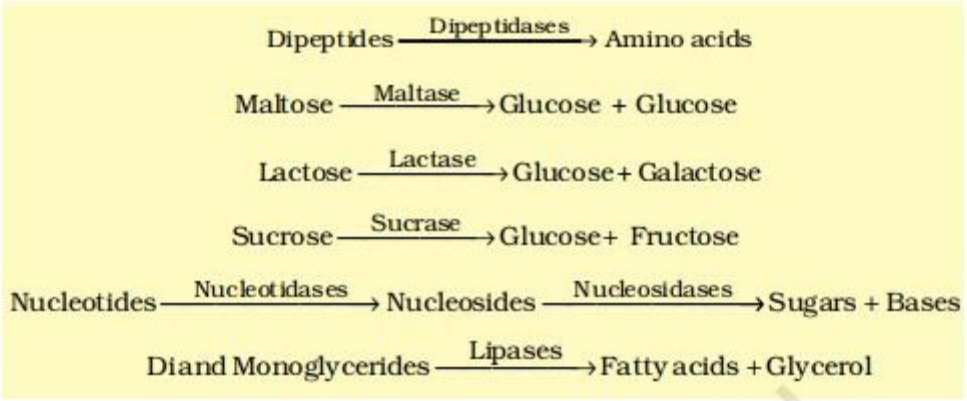
Learn more about Disorders of Digestive System here in detail.

The different chemical reactions that occur are summarised below:

- *Pancreatic juices:*
  - Amylase converts starch into Maltose.
  - Enterokinase converts Trypsinogen into Trypsin
  - Trypsin converts proteins into Dipeptides
  - Trypsin converts Chymotrypsinogen into Chymotrypsin.
  - Chymotrypsin converts peptones into Dipeptides.
  - Trypsin converts Procarboxypeptidase into Carboxypeptidase.
  - Carboxypeptidase converts proteoses into Dipeptides.
  - Trypsin converts Proelastase into Elastase.

- Elastase converts elastin into Dipeptides.
- Pancreatic amylase converts polysaccharides (Starch) into Disaccharides.
- Nucleases in the pancreatic juice, act on nucleic acids and form nucleotides and nucleosides.

- *Intestinal juices:*
- Maltase converts maltose into glucose.
- Sucrase converts sucrose into glucose & fructose.
- Lactase converts lactose into glucose & galactose.
- Aminopeptidases convert peptides into amino acids.
- Dipeptidases convert dipeptides into amino acids



(Source: NCERT)

- *Bile* -Bile converts fat globules into fat droplets through a process called emulsification. Fats are broken down into diglycerides and monoglycerides.
- *Pancreatic lipase* – It converts triglycerides into fatty acids & glycerol.

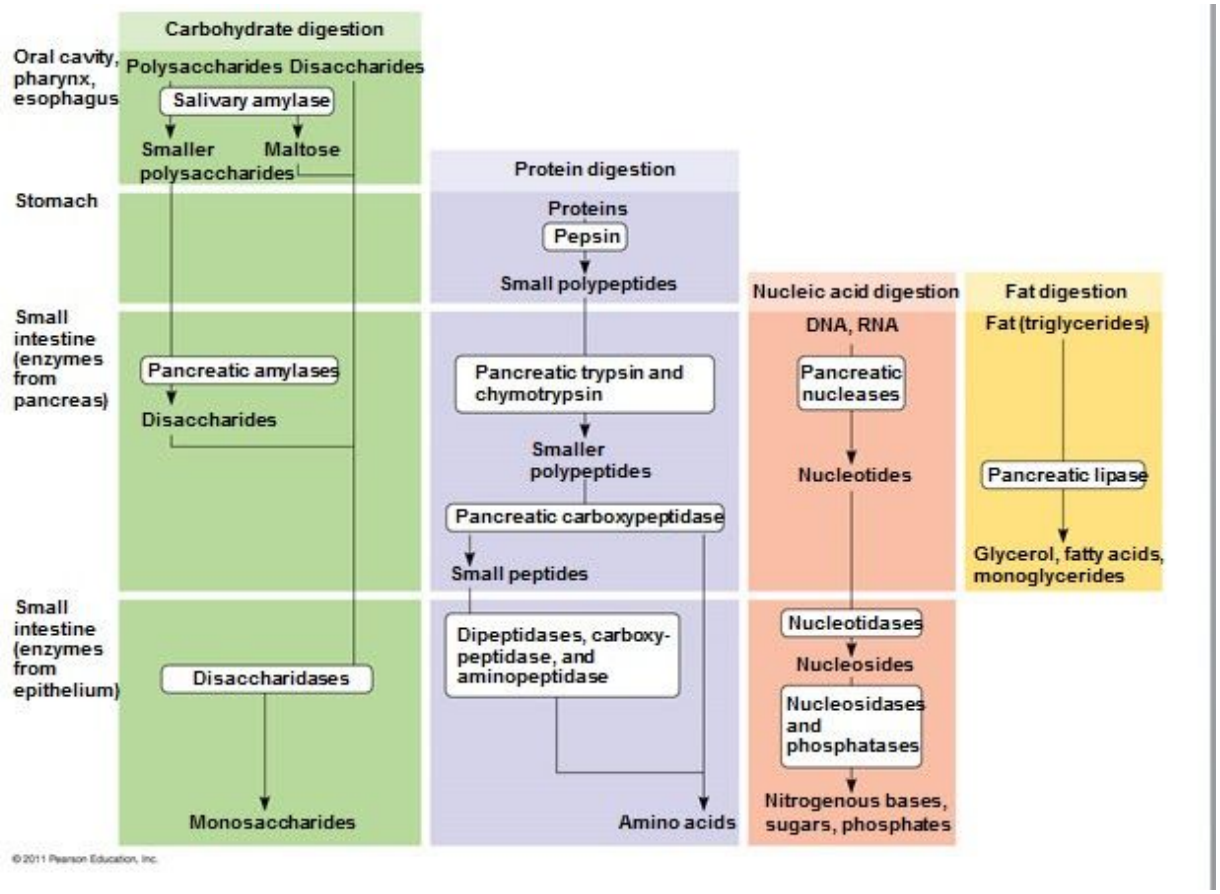
The biomacromolecules are broken down in the duodenum region. All the simpler forms of the digested food are absorbed in the jejunum and ileum regions. Any leftover undigested, unabsorbed food particles are then passed on to the large intestine.

What is Absorption and Assimilation?

Digestion in the Large Intestine

In the large intestine, the digestion activity is significantly less. Here, bacterial action on the leftover food particles occurs. Minerals, water, and certain drugs are absorbed in the large intestine. The mucus secreted by the large intestine helps in holding the waste particles, apart from lubricating it.

Any undigested and unabsorbed waste particles called as the faecal matter, are then passed to the rectum, from where it is eliminated through the anus.



(Source: Pearson Education)

Control of the Digestive Processes

The digestive processes are controlled by the hormones and the nerves. There is a constant flurry of signals between the brain and the alimentary canal. Hormones control the digestion process by

signalling the body at appropriate times to make the digestive juices. They also send signals to the brain to indicate being hungry or full. The nervous system, through the brain and spinal cord, controls the digestive processes.

Solved Questions For You

Q: Why is bile important?

Ans: Bile is secreted by the liver. It plays an important role in the emulsification of fats. Bile juice also helps in the absorption of fats. The bile salts reduce the surface tension of the large fat droplets and make them into smaller droplets. Lipase acts on these smaller fat droplets. Lipase is activated by bile. Bile is important due to its significant role in the digestion process.

Q: If HCl is not secreted in the stomach, what would happen?

Ans: HCl activates pepsinogen which is then converted into pepsin. This acts on proteins. In the absence of HCl, protein digestion does not take place. HCl also helps in killing the bacteria in the stomach.

Absorption and Assimilation

So once you eat your food, how does the body extract the ingredients that it requires? Would you be surprised to know that this function actually happens in your small intestine? The process is known as Absorption and Assimilation. Let us learn about it here.

Absorption and Assimilation

As the food gets broken down into smaller and simpler particles, it has to get absorbed into the bloodstream. It is only through the blood and circulatory system that the digested food reaches various cells and tissues. Blood coming from the digestive organs carries simple sugars, glycerol, amino acids, and a few vitamins and salts to the liver. The liver stores and processes these substances. They are also detoxified here. It delivers the nutrients to the rest of the body, as and when needed. This entire process is summed up as Absorption and Assimilation.

The process through which the end products of digestion are absorbed into the blood or lymph from the intestinal mucosa is called as Absorption. This process occurs either by the passive, active or

facilitated transport mechanisms in the body. The small intestine is the organ where absorption occurs. It is specially adapted to carry out this function.

Browse more Topics under Digestion And Absorption

- Digestive System
- Process of Digestion
- Disorders of Digestive System

What happens to the Digested Food in the Small Intestine?

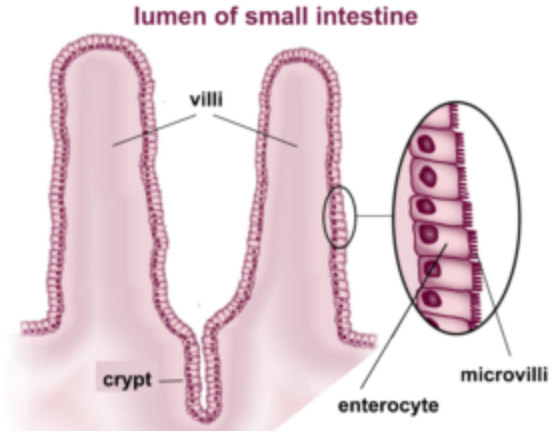
The small intestine has special cells that help absorb nutrients from the intestinal lining into the bloodstream. It has many physiological features that help in this absorption process. It is a long convoluted tube-like organ, which is around ten feet in length and has a diameter of one inch. There is a thin membrane called the mesentery that surrounds the small intestine and anchors it in place.

Many blood vessels, lymphatic vessels, nerves pass through the mesentery. They provide support to the tissues of the small intestine

and also help in the transport of nutrients from intestines to the rest of the body.

The small intestine is divided into three regions:

- Duodenum- It is the first section which connects to the pyloric sphincter of the stomach. It is the shortest region of the intestine. The chyme gets mixed with bile and pancreatic juice here.
- Jejunum – It is the middle section and is the primary site of nutrient absorption. This region measures around 3 feet in length.
- Ileum – It is the final section of the small intestine that empties into the large intestine. At a length of 6 feet, it completes the absorption of the remaining nutrients.



(Source – Wikimedia Common)

Absorptive area of the Small Intestine

The huge absorptive surface area of the small intestine is due to the presence of the mucosal folds, villi, and microvilli. These are the three distinguishing features of the small intestine. The rest of the structure is similar to the other areas of the alimentary canal.

The villi and microvilli are exposed to the intestinal lumen. The vast microvillar surface creates a brush border. This increases the rate of nutrient absorption to a great extent. Through the epithelium of the villi, the digested food molecules pass from the lumen of the intestine to the blood capillary network or lacteals.

Amino acids and monosaccharides that enter the blood capillary network are carried away by the blood. But, larger molecules from the

digestion of fat enter the lacteal. These are then emptied into the lymphatic system, which eventually discharges its contents into the blood system.

Through the processes of Osmosis and Diffusion, water and fatty acids are absorbed. The other nutrients such as glucose, amino acids, & minerals are absorbed by active transport.

Assimilation

In the process of absorption and assimilation after digestion and absorption, the nutrients that are present in the blood reach the target cells and tissues which utilize them for their activities. This process of synthesizing the biological compounds (macromolecules) from the absorbed simple molecules is called assimilation. It helps in the cell growth and development and new cell production.

Solved Questions For You

Q: Why are villi present in the small intestine and not in the stomach?

Ans: The small intestine is mainly responsible for the absorption process. The villi and microvilli increase the surface area of absorption. The stomach, on the other hand, is an organ that primarily

stores food temporarily along with the digesting proteins. Hence the small intestine has villi and not the stomach.

Disorders of Digestive System

Surely you have suffered from acidity or heartburn perhaps? Or had uncomfortable stomach pain due to unhealthy food choices? Well, then you have suffered from Digestive System Disorders. Apart from these, there are also some serious diseases of the digestive system. Let us study their causes and prevention.

Digestive System Disorders

Disorders of the digestive system or the gastrointestinal tract are quite common. Inflammation of this tract is commonly caused by bacteria and viruses. The intestine can also be infested with parasites like Tapeworm, Hookworm, Pinworm, Roundworm, and Threadworm etc. These parasites can cause infections that need medical attention.

Apart from the above stated, some disorders of the digestive system also include abdominal pain, nausea, vomiting, bloating, constipation, heartburn, diarrhoea, incontinence, difficulty in swallowing etc.

Most of the diseases of the digestive system are related to the food that we eat. A controlled diet, at many times, can help in reducing the discomfiture caused by certain foods. The ailments of the digestive tract can be easily detected by some specialized tests. Come standard testing procedures include colonoscopy, endoscopy, ultrasound etc.

Digestive system disorders also include Jaundice, Vomiting, Diarrhea, Acid Reflux, Constipation, Appendicitis, Indigestion, Inflammatory Bowel Disease, Gallstones, Hemorrhoids, Irritable Bowel Syndrome, Lactose Intolerance, Stomach Ulcers etc. Let us look at these in some detail.

Jaundice

(Source: heathprep.com)

It is the excess accumulation of bile pigments in the bloodstream. In jaundice, there is a yellow discolouration of the skin, the whites of the

eyes as well as the mucous membranes. This is caused by the increased amount of bilirubin in the blood, which is a byproduct of the breakdown of RBC's in the body. Normally liver is involved in the metabolism and excretes bilirubin, in the form of bile. Any disruption in this metabolism causes jaundice. It is a most common form of the disease hepatitis.

Nausea and Vomiting

*W*hen there is irritation in the stomach, sometimes the stomach contents get ejected from the mouth. This is a reflex action and is called as vomiting. There is a forceful discharge of the stomach contents that come out of the mouth. The uneasiness that usually comes before vomiting is nausea. Vomiting and nausea are generally the symptoms of conditions such as food poisoning, stomach flu, gallbladder disease, ulcers, overeating etc.

Blood in Stool

It is an indicator of a serious problem, that signifies that there is some bleeding in the digestive tract. Anal fissures, Diverticular disease, Peptic ulcers, oesophagal problems etc. could be some of the possible causes of blood in the stool.

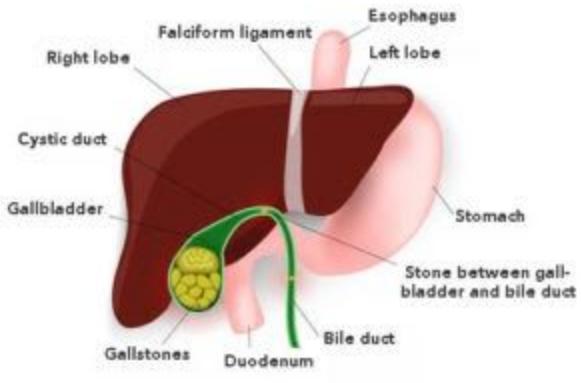
Peptic Ulcers

Peptic ulcers are holes or breaks in the protective lining of the duodenum or stomach. Duodenal ulcers, stomach ulcers are the types of ulcers, according to the position where they occur. Oesophagal ulcers also occur at times, due to alcohol abuse or exposure to certain antibiotics.

Diarrhoea

It is the abnormal frequency of the bowel movement. There is an increased liquidity of faecal discharge. The stools are loose and watery. It is generally caused by viruses that cause the infection of the gut.

Gallstones



(Source: WebMD)

These are small pieces of solid material that we find in the gallbladder. When they block the bile duct, it causes immense pain and needs to treated immediately.

Solved Questions For You

Q: Alcohol abuse can cause many digestive disorders. Justify.

Ans. Alcohol causes immense damage to the body. Alcohol abuse has a hugely negative impact on the liver. The liver produces bile. If liver gets damaged, then it cannot produce enough bile, which is required for the emulsification of fats. This causes a major disturbance in the digestion and absorption of food. The stomach wall also tends to become harder, churning less food. Alcohol damages the lining of the stomach, causing gastritis. Heartburn, inflammation of the pancreas, alcoholic liver diseases etc. are some of the digestive diseases that alcohol abuses causes.